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ABSTRACT

This experiment was designed to test whether paired objects described as interacting through movement are more memorable to young children than the same objects described as alike in structure or color. Drawings of eight familiar objects were presented in unfamiliar combinations to forty-five 4-year-old subjects. Objects were described as interacting or as sharing common properties. Preliminary analyses supported the assumption that chosen combinations did not favor either experimental description. Subjects were able to reconstruct associations among combined objects significantly more often when objects were linked by actions than when they were described as alike in structure or color. Associations based on likenesses were reconstructed significantly more often than associations without action or likeness descriptions. It was concluded that the actions and responses of objects are an important dimension of early object concepts. (Author/SS)

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Actions versus Likenesses
As Determinants of Early Object Concepts

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Abstract

The experiment described in this report was designed to test whether paired objects described as interacting are more memorable to young children than the same objects described as alike in structure or color. Eight familiar objects were presented to 4-year-old subjects in unfamiliar combinations. Objects were described as interacting or as sharing common properties. Preliminary analyses supported E's judgement that chosen combinations did not favor either experimental description. Subjects were able to reconstruct associations among combined objects significantly more often when objects were linked by actions than when they were described as alike in structure or color. Associations based on likenesses were reconstructed significantly more often than associations without action or likeness descriptions. It was concluded that the actions and responses of objects are an important dimension of early object concepts.

Actions versus Likenesses
as Defining Dimensions of Early Object Concepts

From the time of Aristotle, concept formation has been described as a process of abstraction--a process of observing likenesses among objects and grouping like objects together (Aristotle, Posterior analytics, 97b, 7-16; cf. Anglin, 1977; Bruner, 1956, 1957; Gibson, 1969; Hull, 1920; Johnson-Laird & Wason, 1977). Words for things, according to a related interpretation, are defined by lists of distinguishing features based on observed likenesses (Clark, 1973; McNeil, 1966). For example, having a concept of a ball means knowing ways in which balls are alike; knowing the word "ball" means knowing that "ball" is the proper expression for things alike in this way. Abstraction interpretations, accordingly, provide a unified account of concept formation and language learning, processes which might otherwise seem independent.

A unified account of lexical concept formation is also supported by an effect called "word overextension." This phenomenon occurs when words are used to refer to objects outside the compass of standard meanings; for example, when the word "ball" is used to refer to oranges or light-bulbs as well as balls. Word overextension has been widely reported by observers of first language learning (Clark, 1973,

1977; cf. de Villiers & de Villiers, 1978, 1979). According to abstraction interpretations, it results from defining a word like "ball," or forming a concept of ball, on the basis of a single feature such as round shape. "Ball" then refers to any object which shares this property, in effect grouping objects which are alike in a way that has become salient to the young child.

This is a clear and compelling account, yet there is evidence that it minimizes an important part of the process of early conceptualization. Recent evidence suggests strongly that many early concepts are formed as a product of the child's interactions with single objects, not by grouping like objects together. Evidence reported and reviewed by Nelson (1974a, 1977a) appears to show that objects are first defined singly, by their responses to children's actions, or by spontaneous movements or changes. Yet the overextension data suggest, to the contrary, that early concepts are the result of grouping objects on the basis of common properties. One hypothesis attempts to reconcile these data by disuniting concept formation and language learning. It may be that grouping objects on the basis of shared properties is part of the process of forming natural language categories, but not the means by which we initially determine the way things are. Piaget (1951, 1952), and later Bruner (1964) and Nelson (1974a, 1977b), have offered variations of this interpretation,

stressing that our knowledge of the world is at first primarily knowledge of movement and change. According to a recent, congruent theory of memory (Schank, 1976), our knowledge is initially coded and stored in the form of episodes of experience. Concepts are addresses to locations in an episodic memory. They are fundamentally remembered interactions or remembered encounters with things.

To summarize, one alternative to abstraction accounts of early conceptualization is that the fundamental character of objects is determined initially by their responses to children's actions. Object concepts are at first addresses to remembered interactions or encounters with things, not lists of features based on observed likenesses. Likenesses, in contrast to actions, determine how objects are to be grouped and labeled. Features based on observed likenesses are added to conceptual definitions as part of the process of forming semantic categories. They are not the means by which children initially determine the way things are.

Within this framework, several inferences were tested as follows.

First, a task was designed to separate the effects of actions and likenesses. The task confronted four-year-old subjects with familiar objects in unfamiliar combinations. For each object pair, two descriptions were generated--one which described the objects as interacting, one which described the objects as alike in structure or color. It was argued

that familiar objects combined in unexpected ways would represent to four-year-olds a challenge similar to the challenge posed by unfamiliar objects to younger children. It was concluded from pilot work that four-year-olds were the youngest population capable of responding to a concept learning task of this type.

Objects were chosen to fit naturally and fairly into the two description formats--actions versus likenesses. A preliminary analysis, described below, supported E's judgement that the objects chosen were not biased toward either experimental description.

It was assumed that if likenesses are conceptually fundamental, as abstraction theories suggest, then associations based on likeness descriptions would be easier for young children to reconstruct from memory. It was argued that associations based on actions would be easier to reconstruct only if actions are conceptually more fundamental than likenesses.

Method

Subjects

Forty-five children ranging in age from 4:0 to 4:11 served as subjects. Mean chronological age was 4:6. All subjects were recruited from university community childcare centers or from married student housing. There were approximately equal numbers of boys and girls across

groups.

Materials

Stimuli were Xerox copies of realistic line drawings mounted on black, 5 x 6 inch poster board. Represented were a bottle, a window, a pair of scissors, a pot, a bag of flour, a cat with a ball, a can of paint, and a pitcher of juice.

Experimental descriptions arranged the pictured objects into four pairs and three groups of pairs as shown in Figure 1. In the likeness condition, the collection of eight pictured objects (labeled A in Figure 1) was described as "things that can go together." The pairs labeled B were described as objects that go together "because they are made of the same thing." The pairs labeled C were said to go together "because they are colored the same." The bottle and the window (pair D) were said to go together "because they are made of glass"; the scissors and the pot (pair E), "because they are made of metal." The flour and the cat (pair F) were said to go together "because they are both white"; the juice and the paint (pair G), "because they are both purple."

In the action condition, the collection of eight objects (labeled A in Figure 1) was described as "things that got mixed up." The pairs labeled B were "things that got blown together"; the pairs labeled B were "things that

fell onto each other." The bottle "blew into the window and broke the glass" (pair D); the scissors "blew into the pot and scratched the metal" (pair E). The flour "fell onto the cat and turned him white" (pair F); the paint "fell into the juice and turned it purple" (pair G). Under both experimental conditions subjects heard the expressions bottle, window, glass; scissors, pot, metal; flour, cat, white; paint, juice, purple. Under one condition these expressions were part of an action description; under the other they were part of a likeness description. Under a third, control condition, pairs were labeled but not described.

In the action condition, the configurations labeled A-C resembled episodes of a story: first, things were blown together; then, things fell onto one another. In the likeness condition, the configurations labeled A-C were superordinate groups: there was a group of objects made of the same thing and a group of objects colored the same. A contrast between story and category structure was therefore available for analysis independently of the contrast between actions and likenesses.

Procedure

A pretest and two practice trials were administered to each subject. The purpose of the pretest was to insure that subjects had an independent understanding of the properties and relationships attributed by experimental descriptions. For example, subjects were shown an array of metal, glass.

and wooden objects and asked to find something made of wood, made of metal, and made of glass. Of 60 recruited subjects, 15 missed two of the 13 pretest items, or missed one item on two occasions, and were dropped from the study. The pretest and the experiment were administered during separate visits to individual subjects. Materials used for the pretest and practice trials were different from those used in the experiment.

Following the pretest, subjects were randomly assigned to one of three treatment groups: action, likeness, or control. The experimental presentation consisted of mounted drawings displayed in the same order to all subjects. Drawings were placed in shallow boxes painted dark blue. The boxes were arranged side by side; each accommodated two individual drawings. As drawings were cued by accompanying descriptions, they were placed in a box before the subject, displayed for five seconds, then turned face downward. When all eight drawings were face down, subjects were unexpectedly asked to recall the names of the pictured objects. The number of objects recalled and the number of target pairs recalled were dependent measures for this task. By definition, a target pair was recalled whenever two objects recalled in succession corresponded to pair D,E,F, or G.

The free recall was followed by two reconstruction

trials. Reconstruction trials were separated by a description recall. For this recall subjects were asked to repeat the action or likeness descriptions which had accompanied stimulus presentations, or asked to recall the labels which accompanied presentations in the control group. The dependent measures for the description recall were the same as for the free recall. The reconstruction tasks were as follows.

Drawings, face down following the free recall, were scrambled prior to the first reconstruction trial. Subjects were required to turn them face up and to restore the original presentation order. Following the first reconstruction trial, subjects were asked to repeat the descriptions which had accompanied stimulus presentations, then asked to revise their first attempted reconstruction if they wished. This was the second reconstruction trial. The dependent measure for these tasks was the number of recovered target pairs.

An attempt was also made to assess the degree to which subjects had recovered the relationships labeled A,B,C in Figure 1. This was as follows.

Reconstruction of relations A,B,C was dependent on the recovery of constituent pairs D,E,F,G. The scale of measurement for this analysis was therefore a ratio of recovered to available A,B,C relationships. An A,B,C relationship was available only if its constituent D,E,F,G pairs had both been recovered. Subjects failing to recover constituent

pairs were dropped from this comparison. The comparison was tested by an unweighted means analysis.

Results and Discussion

In preliminary analyses sex was not a significant source of variation. Sex appeared four times as a main effect and as a component of six interactions; all were non-significant. Pairs also appeared as a source of variation in preliminary analyses. This was to determine whether the chosen stimulus pairs were biased toward the action or likeness descriptions. The analysis was a 2×4 design, with two experimental treatments as a between- and four target pairs as a within-subjects factor. Bias would be suspected if a significant pairs by treatments interaction were obtained. Both the main effect of pairs and the pairs by treatments interaction were nonsignificant, $F(3,84) = 0.69$, $p > .10$, and $F(3,84) = 0.08$, $p > .10$, respectively. Pairs and sex did not appear as sources of variation in subsequent analyses of the data.

Reconstruction

Differences in the number of target pairs regenerated across experimental treatments and reconstruction trials are shown in Figure 2. Both the treatments and the treatments by trials effects were significant, $F(2,42) = 18.29$, $p < .001$, and $F(2,42) = 6.64$, $p < .003$, respectively. The main effect of trials did not reach significance, however,

$F(1,42) = 1.19, p > .10$. Comparisons within treatments indicated a significant increase in performance across reconstruction trials only in the action group, $F(1,42) = 12.06, p < .01$. The test was Dunn's multiple comparison procedure, using an F ratio (Kirk, 1968, p. 81). Eight other comparisons among individual trial and treatment

Insert Figures 1 and 2 about here

means were of interest, as follows. All tested hypotheses were directional.

Performance in the action and likeness groups was superior to performance in the control group on both reconstruction trials. All four contrasts between experimental and control groups were significant at less than the .01 level. However, between the two experimental groups there was a significant difference only on reconstruction trial 2. Following the description recall, the number of target pairs recovered was greater in the action group, $F(1,84) = 16.06, p < .005$. To summarize: performance improved across trials only in the action group; across treatments, performance was superior in the action group on trial 2 but not on trial 1.

It appeared from these data that action and likeness descriptions aided reconstruction performance about equally

on reconstruction trial 1. However, when subjects were prompted to recall the experimental descriptions and to correct their first reconstruction, performance improved in the action but not in the likeness group. One possible reason for this effect may have been that the action description was more memorable and more easily recalled than the likeness description--this because actions are conceptually more fundamental and more meaningful than likenesses. The recall data supported this interpretation.

Recall

The effect of treatments for the description recall was significant, $F(2,42) = 12.07$, $p < .001$. Treatment means were 2.80, 1.80, and .73 respectively for the action, likeness, and control groups. The superiority of the action over the likeness group, and of the likeness over the control group, also reached significance, $F(1,42) = 5.86$, $p < .05$; $F(1,42) = 6.50$, $p < .05$.

For the initial free recall, differences across treatment groups did not reach significance. The mean number of individual objects recalled for all groups was 2.2 out of a possible 8. The mean number of target pairs recalled was 0.4 of a possible 4. The probability of $F(2,42)$ exceeded .10 for both measures. The difference between the number of target pairs recalled and the number expected by chance was reliable, however, but only in the action group, $t(14) = 2.21$, $p < .05$.

So far, the results of this experiment appear to demonstrate a powerful effect for action in contrast to likeness descriptions. This effect was manifested in several ways. First, recall was uniformly low across treatment groups, and reconstruction was relatively low across experimental groups--until subjects were prompted to recall the descriptions which had accompanied stimulus presentations. Following the description recall, reconstruction increased only in the action group, apparently because the action description was more readily recalled than the likeness description. In the action group, the number of recalled target pairs rose to a mean of 2.80 for the description recall from a mean of 0.53 for the free recall. This effect was certainly due in part to the fact that individual pictured objects were visible for the description recall and covered for the free recall. But the effect was appreciably greater in the action than in the likeness or control groups. Following the description recall, reconstruction performance declined slightly, but not significantly, in the likeness group. Even then, performance in the likeness group was superior to performance in the control group, but following the description recall, the action group exceeded the difference between the likeness and control groups by an equal magnitude.

It therefore appeared that for the objects and descriptions employed in this experiment, associations

based on actions were more beneficial for reconstruction and recall than associations based on likenesses. In the present theoretical context, this outcome was interpreted as supporting the hypothesis that actions and responses of objects are conceptually more fundamental than object likenesses. However, it is possible that this effect may have resulted from the fact that the relationships labeled D,E,F,G in Figure 1 appeared within larger structures. In the likeness condition this was a category structure; in the action condition it was a story structure. The obtained results may therefore have reflected a story-versus-category rather than an action-versus-likeness effect. To test for this possibility, reconstruction of story and category relationships (labeled A,B,C in Figure 1) was also analyzed, as follows.

Constituent, D,E,F,G pairs were recovered by approximately half of the subjects in each of the two experimental groups, but only by one subject in the control group. The control group was therefore not included in this comparison. With the ratio of recovered to available A,B,C relationships as a dependent measure, there were no significant differences in the reconstruction of story or category structures. Values of $F(1,13)$ for the unweighted means analysis were 0.02, 1.55, and 1.55 respectively for the treatments, trials, and interaction effects. The probability of F exceeded .10 for all three sources. It was therefore

concluded that the larger, story and category structures did not appreciably influence the outcome of this experiment. Instead, the obtained results seemed best explained as an action versus likeness effect. Two concluding observations are in accord with this interpretation.

First, researchers in the area of early conceptualization have reported few unambiguous trends or effects. For example, some investigators have reported evidence of an increase in likeness-based concepts between early and later childhood, and a corresponding decrease in relational and complementary concepts (Kagan, Moss, & Sigel, 1963). Other investigators have reported increases in both complementary and likeness concepts (Denny & Moulton, 1976). And there are other examples of conflicting data, some of them cited earlier in this report. The results of the present experiment suggest, however, that this lack of clarity may result in part from the fact that investigators have rarely centered on the contrast between actions and likenesses. Objects may be related, or complementary, without interacting. A cup and saucer or a window and shutters are examples. The present study suggests strongly that the actions and responses of objects are critical to the process of concept formation, and that the contrast between actions and likenesses may be a more important dimension of early conceptualization than the contrast between complementarity and similarity.

Second, the stress on abstraction and comparison in American education is apparently deeply rooted in Western culture. It appears likely that the notion of conceptualization as a process of grouping like objects together belongs to a philosophical tradition stretching back at least to Aristotle. Denny and Moulton have recently argued (1976) that training in shapes and colors, so common in American preschools, serves to orient young children to a type of conceptual relationship stressed in all of subsequent education--a type of relationship which is fundamental to our Western view of the world. However, it appears that our initial sense of the way things are is as much a sense of the way objects move and respond as it is a sense of the ways they are alike. The balance of evidence seems to show that our stress on abstraction and comparison ought not to diminish children's chances to actively explore and respond to their surroundings.

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Figure 1. Graph of 7 target relationships among
8 presented objects.

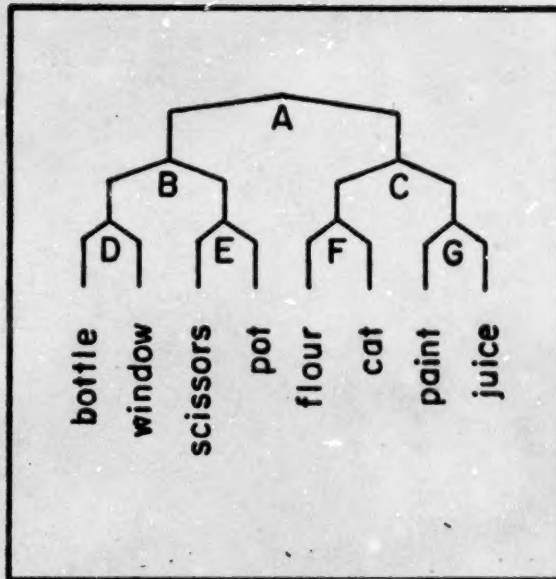


Figure 2. Graph of target pair means as a function of reconstruction trials for the action, likeness, and control groups.

TARGET PAIR MEANS

TRIALS

